

# The Case for an Epistemography of Montage

## The Marey Moment

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My long-term ambition is to redefine the concept of montage in the cinema.<sup>1</sup> But this ambition is part and parcel of a wider field of enquiry of an epistemological nature, which entails adopting a certain viewpoint on the *Marey* question or *Marey* 'moment' in the history, prehistory and archaeology of cinema.<sup>2</sup>

It started to become clear that the concept of montage needed to be redefined when, in the 1980s and 1990s, scholars specialising in early cinema saw – first in the films of Méliès, then of Lumière and Edison – that there were processes of montage that stood in stark opposition to the *doxa* associated with the term. Researchers like Jean Giraud, the lexicologist – who identified the first use of the term in 1909<sup>3</sup> – and historians like Jean Mitry, or the theorists and philosophers of the cinema who came in his wake, agree that montage only exists when there is a certain narrative, discursive and stylistic development of the cinema, whether it is a process of narrative (sequence) or exhibition (parallelism), or a trope ('metaphor', analogy, or series).

But this approach is clearly limited by a prejudgement of an aesthetic nature, and, hence, obfuscates the very core of the matter and prevents one from apprehending the true nature of cinema.

In 1984, when André Gaudreault identified Méliès as the pioneer of the link shot, Pierre Jenn suggested that Méliès's operations of special effects, assemblage and substitution be examined in terms of montage or proto-montage.<sup>4</sup>

There is the well-known story – which Méliès himself referred to in 1907<sup>5</sup> – about the camera accidentally stopping for one minute while filming on Place de l'Opéra. The result was that an omnibus became a hearse and men changed into women. This was seen as the beginning of the special effect 'by substitution' and was later used for different effects of 'conjuring away' or transforming a character or object before the spectators' eyes. But what is not known is that Méliès wrote that he only mentioned this effect after having 'stuck together' the film 'where it broke' – i.e., after having cut and mounted the film. Later it was learnt that, in any case, the inertia of the handle powering the camera would have made it impossible to have a 'magic' substitution operation by simply stopping the film and starting it up again, and that a certain number of photographs that progressively became darker and then lighter had to be removed

and the film 'stuck together' in all events. The substitution trick was thus inseparable from a montage operation, even though the word had not yet made its appearance.<sup>6</sup>

It is moreover symptomatic that when Eisenstein referred to this episode, he saw an effect of *superposition*, a term that he considered as the very 'basis' of montage.<sup>7</sup>

Then Gaudreault went back in time and closely studied the original Lumière films. He discovered that they also had discontinuities and breaks, so he went on to examine Edison's work and take a look at optical toys<sup>8</sup> – thus corroborating the poetics of the film director Werner Nekes, which was predicated on his knowledge as an enlightened amateur and collector, and on his work in experimental cinema.<sup>9</sup>

This transformation in the approach to these films means not only moving back the date when montage first appeared, it also means redefining the notions used.

In order to rework the concept of montage and the associated notions, one needs to draw up what Michel Foucault in 1969 called an 'epistemography'. During the *Journées* organised at the *Institute d'histoire des sciences* under the auspices of Georges Canguilhem, where Foucault was speaking about 'the Situation of Cuvier in the history of biology', a discussion took place about the analysis of the 'Cuvier-transformation' in *The Order of Things*. In his relatively sharp reply to an exposé by François Dagognet, Foucault proposed to distinguish three levels of epistemography: the epistemocritical (*épistémocritique*), epistemonomical (*épistémonomique*) and epistemological (*épistémologique*) levels.<sup>10</sup>

We shall make the following distinctions: a) the technico-aesthetic discourse on montage (the *epistemonomical* level), which consists of a set of limits and control principles and 'rules'; b) the prescriptive discourse of criticism and cinema theory (the *epistemocritical* level) defining the processes of belonging to or being outside the concept of montage; in order to construct: c) an '*epistemological*' level, which identifies the fields of application of the concepts and rules of usage regarding montage, and their transformations and variations in order to link them to their conditions of possibility.

The issue here is to foster comprehension of the conceptual field of montage (via such notions as end, piece, moment, interval, intermittence, pause, phase, position, jerk, shock, dissociation, cut, break, interruption, discontinuity, joining, assembling, collage, link, continuity, articulation, succession, etc.) by leaving behind the purely internal, descriptive or prescriptive definitions and going beyond the obstacles of the technological type, which impede or limit comprehension.

It will then be possible to: a) identify the contours of a montage function, which may not be given that name but which needs to be linked to various

procedures, practices and utterances (as we have just seen with Méliès and Lumière); b) locate the thinking related to montage in the system of concepts and practices where it has its roots, and subsequently envisage its extension and variability; c) and finally address the question of ‘what *governs* statements, and the way in which they *govern* each other so as to constitute a set of propositions that are scientifically acceptable’, i.e., the regime and politics of these utterances.<sup>11</sup>

## The Marey ‘moment’

In the perspective described above, the Marey ‘moment’ is crucial for several reasons:

- a. he is outside cinematographic teleology (he did not ‘attempt’ to ‘arrive at’ the spectacle of an animated image that would be identified under the names of kinetoscope, phonoscope, cinematographe, etc.);<sup>12</sup>
- b. he was nonetheless present in the sequence of ‘cinema’ inventions (both conceptually and technically speaking) and gave the ‘invention’ both a scientific and a social guarantee (*Académie des sciences, Collège de France*);
- c. he belonged to a field – physiology<sup>13</sup> – that had been well explored in conceptual terms and that was the theatre of fundamental controversies between opposing tendencies, abounding in a body of notions, concepts and practices which, in his particular case, was to provide an ‘interface’ with the toys and machines used for animated images.<sup>14</sup>

The result is a fairly striking one when one realises that Marey’s mechanistic conception (the ‘animal machine’) led him to encounter a *machinic* dispositive that is analogous to his object, as an instrument of observation – the ‘cinema’ machine:<sup>15</sup> the ‘animal machine’ whose locomotion is ‘distinct and successive’ (Canguilhem), and the machine with ‘[distinct and] successive images’.

Marey thus successfully developed this dispositive by combining two elements: on the one hand, research aimed at breaking things down in order to understand ‘how they work’ *and*, on the other, a series of illusion-producing machines, which had been developed on other foundations. In other words, there was the combination of a conception of the living being *and* a model to capture reproducible movements.

All of the early cinema protagonists broke down animal and human movements, but with the intention to reproduce them as a continuity, especially via the zoetrope. They considered breaking down movement as a trick or an optical experience.<sup>16</sup> When the research and experiments associated with this process

had a scientific dimension, they involved perception and not locomotion. First came observation and then the speculation regarding the inability of the eye to discriminate between the moments in rapid succession to force it to 'digest' the illusory synthesis or continuity of the thaumatrope, zoetrope, phenakistoscope, praxinoscope, etc.

While Plateau and others developed the scientific knowledge of human vision, i.e., its physiology, Marey's interest as a scientist was neither in vision nor in astronomy. He focused on movement.<sup>17</sup>

For him, 'understanding the movement of a body' meant 'understanding the series of positions it occupies in space during a successive series of instants'.<sup>18</sup> These instants are discrete and pertinent elements, which define the process of locomotion, jumping, etc. When Pierre Jules Janssen improved the 'cinema' dispositive in order to improve observation of Venus, he broke down its path as it passed in front of the sun into successive movements, but without considering the fact that they were 'remarkable' moments of the planet's progress around the sun. 'Celestial mechanics' are not found on that level. These moments result from observation, and it is subsequent analysis that will select the 'particular' or 'remarkable' moment or moments.<sup>19</sup> Marey, however, was convinced that human movement is not made up of a random series of moments but of successive positions, which he could determine once they were captured.<sup>20</sup>

His experimental protocol (capture, transmit, analyse, restore) thus included operations that broke down ('*démontage*') the observed phenomenon into its phases, moments or positions, then determined its 'mechanics', then pieced everything together again ('*re-montage*') for the purposes of demonstration, aided and abetted by chronophotography and the zoetrope or, subsequently, using a projector.

There can be no doubt that Marey's approach (only partly shared by Muybridge, among others) played a part in how 'cinema' was conceived in its early years. After all, he provided the new invention with its scientific conceptualisation. Not only was he seen as one of the inventors in learned circles and in public opinion (possibly opposed to another, competing scientist such as Edison),<sup>21</sup> but the Lumière brothers, who were both entrepreneurs and inventors, claimed they were his followers. At the beginning of their 'triumph', they borrowed his term of 'chronophotography in movement', which they continued to construct and perfect until their deaths. Moreover, they wanted to share the title of 'scholars' with him, a move that he did not oppose.<sup>22</sup> As we now know, it was only after his death that Marey was marginalized, for reasons that were on the one hand circumstantial (and perhaps 'sordid'), and on the other hand more profound, i.e., linked to the evolution of the cinematographic spectacle. During his lifetime, he was the person asked to organise the photography and cinema pavilion at the Paris Exhibition of 1900, and he clearly maintained ascendancy

over the discourse on 'cinema', even if he was sidelined both in technical and commercial terms.<sup>23</sup>

One can thus hypothesise that Marey's conception of movement (locomotion, etc.) was based on discontinuity and articulation, and established the main guidelines not only for the new medium, but also for the technological approach to the apparatus whose development and mechanical processes (the drive, etc.) were frequently discussed. 'Cinema' discourse was dominated by topics such as the freeze, intermittence, immobility, interval, jerk or pause, while admiration was simultaneously being expressed for the reconstitution of live movement and creating the impression of real life. It thus does not seem out of place to point out that the idea of 'montage', in the various meanings and modalities listed above,<sup>24</sup> was immediately employed. 'Montage' preceded 'cinema' in the processes used by Marey to analyse movement, and he immediately began exploiting this idea.

However, Marey's model was confronted with an obstacle just as the 'miraculous' synthesis of his theory of mechanics and the cinematographic mechanism was taking place. It was overwhelmed by the *mathesis* to which it belonged.<sup>25</sup> Projection introduced an instance missing from Marey's scientific approach: that of the spectator, the subject who perceives, the 'observer', with the two associated aspects of perception and duration.

Indeed, the way a spectator perceives provides the means of verifying how movements can be broken down. The isomorphism between the mechanisms of the object and the analytical apparatus is not continued in perception. Locomotion finds itself, as it were, supplanted by perception, and transcending perception, which was reintroduced by the projection apparatus, was a prerequisite of Marey's scientific approach (seeing beyond common perception, 'seeing the invisible').

Two outcomes were envisaged to address the first aspect of this 'crisis', but neither of them addressed the actual issue of the 'constitutive' subjectivity that was now an obstacle. The first solution led Marey to discover the techniques that rationalised human behaviour (gymnastics, work movements, the general 'economy' of movements).<sup>26</sup> The other solution led to an ever greater interest in phenomena that challenged geometry, including the mechanics of fluids, the formless, smoke, whirlwinds and wave-like animal movements (the skate or jellyfish).

The second aspect was the arrival of duration, the spectator's subjective experience of time. Until then, Marey had concentrated on kinematics (including its dynamic dimension) and, in the words of Alfred Jarry, '[k]inematics is a geometry in which events have neither past nor future'.<sup>27</sup> Time for Marey was a scale of measurement. Scientific demonstration presupposes situating oneself outside the 'lived' experience of time (that Bergson was to reintroduce).<sup>28</sup>

This epistemological crisis by no means prevented cinema from being 'conceived of' in the 'physiological' terms used in the mechanistic analysis of locomotion, that coexisted with wonderment in front of 'life itself'. Later, cinematographic epiphany and the feeling of duration came out on top, but the combining of the machine with life continued to give rise to theories of montage: Kuleshov, Eisenstein, then Walter Benjamin in particular, continued to link the physiology of movement and locomotion and the mechanics of successive images. After Marey would come others, such as Pavlov, Bekhterev or Taylor.<sup>29</sup>

Anson Rabinbach, in his *Human Motor*, tries to 'snatch' Marey from the nineteenth century language of science and situate his images among the foundations of the canons of twentieth-century art, and to link them with the technology of work (Taylor).<sup>30</sup> Without denying this outright, it is important not to stray too quickly from this scientific and technical discursive field. A related – and accessory – example, that of the French scientist and philosopher Charles Henry, who inspired both impressionists and neo-impressionists, shows why it is interesting to devote a little more space to this issue.

I shall now develop the various points mentioned above.

## Mechanism

When it was stated above that Marey saw the cinema as a *machinic* dispositive that is analogous to the subject he was studying, was it not simply stating the obvious? Is it not true to say that the mechanism that envisages the body as a machine rediscovers in the machine what it had itself put into the body? The circular nature of the argument, when the result is foreseen in the initial data, should not fool us. Jean-Claude Beaune has written that the advocates of the man-machine 'marvelled constantly to find one of those "machines" similar to the one made by man himself in the human body ... There are only pistons, valves and levers'.<sup>31</sup> According to Michel Serres, the Cartesian machine is a 'topography (a description of the shapes of organs) to which one *applies* a sequence of mechanical transmissions'. It is, of course, true to say that Marey the physiologist was a successor of Descartes, Harvey, or Borelli, whose questions he made his own. He apprehended the living being as a machine and all movements as mechanical, always analysing the animal machine, the mechanism of a jump, of the organs, or of work, the mechanics of locomotion, etc.<sup>32</sup> But two points are worth raising here. Firstly, it would be wrong to exaggerate Cartesian naivety – Descartes's method was a comparative one, and for him mechanics had as much a rhetorical function as a heuristic one.<sup>33</sup> It was a question of tak-

ing the automaton, the clock – but also the animal – as a starting point for reasoning, in order to distinguish, classify and thus clear a space for reflection and research that was free from the ideological constraints of the time. Marey did likewise when he stated this admirable and simple truth at the beginning of his scientific career:

When studying the movement of blood, we start from the principle that any movement is subject to physical laws, whatever the nature of the force that brought it into being: thus a stone thrown by the arm of man follows the same trajectory as a projectile fired by a canon-powder; and yet in the one case it is the will of a man, the contraction of a muscle that has given the impulsion, whereas in the other it is physical force that has acted.<sup>34</sup>

Both men describe a space of objective investigation in the face of adversaries who, when all is said and done, evoked the unknowable in the name of God, the soul or the life force. From the moment when it is established that it is possible to analyse movement and the living being and experiment with them, *whatever force has brought them into being*, one leaves behind the controversies of believers, and the scientist's work can begin.

Secondly, the above quotation establishes that there is a community of physical laws that govern both 'natural' and 'mechanical' phenomena. It is not sufficient to say that one applies the latter to the former.<sup>35</sup>

## Machines

When Marey speaks of machines with levers, pistons and valves, he is referring to them as instruments for noting movements and for carrying out investigations. He neither 'rediscovers' the machine in the body nor assimilates the body to a machine – on the contrary, he *exteriorises*. The manufactured machine is not used as a model for the animal machine, but the latter lays down the way in which the former – which will be used to analyse it – is made. The series of apparatuses that he designed or perfected bears witness to this (the sphygmograph, polygraph, kymograph, recording cylinder, etc.) and chronophotography, which was meant to break down the movement of the wing or the fall of a cat, recorded this mechanism because it was based on it, and did not 'create' it by analogy.

It would be absurd to take the comparison between Descartes and Marey any further, as both biology and physiology were profoundly transformed during the two centuries separating them – and, moreover, there was little in common in their aims. But the mechanistic doctrine is conveniently brought back to its



founding father, and the distinction between Marey's mechanism and that of Descartes must be underlined. Descartes wrote: 'the motion which I have now explained follows as necessarily from the very arrangement of the parts ... as does the motion of a clock from the power, the situation, and shape of its counterweights and wheels'.<sup>36</sup>

This is tantamount to saying that his descriptions proceed from anatomy, the observation of organs, muscles, nerves, etc. whose functioning he deduces or understands on the basis of their arrangement. The concern with finding a force or energy moving these dispositives (heat, animal spirits)<sup>37</sup> does indeed exist, but the construction remains a largely deductive one.

Marey, for his part, immediately places cinematics within dynamics, which is not envisaged from the rather mysterious aspect of 'forces' alone. Marey's dynamics was the implementation and working of the mechanism.<sup>38</sup> That precluded cutting up the body (anatomy, vivisection). His interest in the functioning of the animal machine thus put him at odds with anatomists – who were only interested in the cadaver, and claimed that they could deduce the function of organs and their structures by examining them<sup>39</sup> – and brings him closer to the vitalists. But, unlike the latter, he did not give up on the idea of dividing up the body, but without cutting it to pieces, as that breaks up both movement and function.

His approach did not infringe upon the mechanism, but made it more complex, the organism is still simply made up of a series of parts, of pieces assembled according to a system of links creating a series of geometrical and measurable displacements.

The effect is doubled, as François Dagognet has noted: respect of the wholeness of the body and the moving object; the conviction that the observed phenomenon must itself make note of its rhythms, scansion, and pauses by the trace it leaves<sup>40</sup> – traces that are first indicial (curves, traces, notes), and then icono-indicial (the photograph).

If, to be as precise as possible, the system of notation must proceed from the moving object itself (the phenomenon *inscribes itself*), it produces recording machines that exteriorise and imitate the observed traits of the phenomenon. Marey 'changed and aligned the instrument with what he was to evaluate, not the other way round'.<sup>41</sup> This can be seen in the following simple example:

To imitate the *jerks* of horses' traction, it may be necessary to make *facets* and salient angles on the *drum* round which the rope is wound<sup>42</sup> [my italics].

These two characteristics are important as they set Marey apart, and it is thus important to study how his mechanicism is different from that of his colleagues, as research into the mechanics of movement and the animal machine were very popular at the time. To quote just a few names – they appear in his letters – one



may ask what makes him any different from Louis-Félix Giraud-Toulon (the author of *Principes de la mécanique animale ou Études sur la locomotion chez l'homme et les animaux vertébrés*)<sup>43</sup> who attacked him and whom he attacked, or from Samuel Haughton (author of *Principles of Animal Mechanics*),<sup>44</sup> or from the 'mechanotherapist' Dr. F. Lagrange, not to mention Guillaume Duchenne de Boulogne and his *Mécanisme de la physionomie humaine*.<sup>45</sup> There is no doubt that Marey's theories took shape within a whole series of texts, only a small number of which bore his signature, even though there were many of them. But within this collection, leaving aside that similar terms or identical theories may belong to different systems and thus have significantly different effects, it must be underlined that Marey alone linked his physiology to the machine that produced successive images, to the extent that this machine guaranteed that the phenomenon under evaluation could be better imitated.

## Photography, chronophotography

The interest that Marey developed for photography and the photographic series (Muybridge) clearly illustrates his conception of movement as something that can be broken down into specific moments or positions, and hence, his view that it was discontinuous in nature and fundamentally imitative.

Photography – which, according to Laurent Mannoni, was a means of liberating the graphic method 'from its limits and even from its technological impasse'<sup>46</sup> – and later chronophotography provided Marey with a machine which has characteristics that are similar to the body or physiological phenomena: discontinuity, jerks and intervals.

His activity was thus different from that of Janssen, from whom he drew inspiration and who himself pointed to 'the physiological path'. His photographic revolver distinguished phases in the trajectory of Venus, but they were those dictated by the instrument that took them from a continuum (the trajectory) in order to capture the 'decisive' moment when the two planets were superposed. This was followed by a scale of measurement that allowed the event under investigation to be identified. Similarly, Albert Londe's chronophotographs at the Salpêtrière clinic aimed, in the photographer's own words, to meet the challenge of manifestations of paralysis, hysteria, epilepsy, chorea, etc. that were hard to distinguish with the naked eye. 'Hence the need for a special apparatus allowing a number of proofs to be taken at intervals, as close together or far apart as necessary'.<sup>47</sup>

The body-machine as envisaged by Marey *already* comprised the discontinuity matched in and reproduced (and analysed) by the machine.<sup>48</sup> Isomorphism

between the instrument and object analysed was sought: 'the time the slotted disc takes to revolve is coming closer to that of the wing,' he noted;<sup>49</sup> 'the photograph must give me the vibrations of an insect's wing'.<sup>50</sup> In 1879, Muybridge spoke of modifying his 'automatic dispositions' to meet Marey's demands, while, in 1882, he noted that he was 'finding another method that would better correspond to the horse's regular movements'.<sup>51</sup>

Research was obviously not centred on the instant as a privileged moment (the problematic of the 'meaningful' instant belonging to the field of art is marginal here),<sup>52</sup> but on the photographic instant that *coincides* with a phase of the movement – the position or the vibration. It is not a question of time or of the speed of a phenomenon that must be grasped, but its rhythm (speed is measured thanks to an appropriate background, a scale).

This is the commentary he made about Muybridge's instantaneous pictures: 'These positions, as revealed by Muybridge, at first appeared unnatural ... they have taught us to find attitudes in Nature we are unable to see for ourselves'.<sup>53</sup>

The 'pose' (representation) interests the artist while the scholar observes the 'instants' of the phenomenon,<sup>54</sup> just as 'attitudes' (representation) account for the 'successive phases' of the movement of the bird's wings.<sup>55</sup>

Reflection on the instantaneous photograph as any-instant-whatever of the movement, which 'removes a non-significant moment of the succession',<sup>56</sup> corresponds to the isolated image, which is opposed to Lessing's 'pregnant' moment. But is this true in the chronophotographic series and, in particular, in Marey's work? He was seeking to establish precisely what happens in the mechanics of movement, and not simply select *a single* moment. The *revealed* poses reveal what we were not able to see *about nature*: they reproduce the various aspects of a movement.

Marey's aim was neither to capture the decisive 'instant' nor to confer the dignity of art on some instant or other. Londe makes a clear distinction here between his approach and that of Marey:

... as is well known, [the instantaneous photograph] consists in capturing the image of any object in movement from only one viewpoint – that is what differentiates it from the work of M. Marey. It is not only documentary, but the very purpose of the operation.<sup>57</sup>

For Marey, not only was the object not just any random object and the aspect not unique, but the photo was not an end in itself.

## Temporalities

The question remains of whether this division of time establishes a different type of temporality from that of the animal machine, from the moment when the relevant phases, points and instants dividing or shaping the phenomenon are subjected to the regularity and mechanical repetition of *the instrument itself*. When Muybridge spoke of making his 'successive exposures at regular intervals by means of a clock' to obtain more precision, he adjusted his camera in relation to an exterior machine – the clock – and no longer to the animal machine to which he wished it to 'correspond'. The instantaneous photographs thus became any-instants-whatever. Now, 'any-instant-whatever' is required by the projector, which needs to use rigorously equal intervals and equidistant images in order to reconstitute movement and cause the caesura to disappear – this is the photogram. However, the photogram operates at a different level from the chronophotographic shots that Marey was interested in: its potential for recreating apparent movement does not come from its correspondence to a relevant articulation of the gallop or the walk, a discrete unit of locomotion – it cuts up at a lower level, even if it contains the unit as well. To be more precise, Marey's project (the theory) differed from the idea of regularly capturing any instants whatever, but his practice, i.e., the actual recordings, did just that, since he used series of twelve and then twenty images per second and constantly worked on the speed and regularity of the intervals. The intervals allowed improvements in the recording of the phenomenon as they became more and more dissociated from the caesura that characterised it. The theory was based on *mediation*, and chaining: it is clear that 'the series of *successive* images representing the *different* positions ... occupied by a body during a series of successive instants' (definitions from both 1878 and 1882 [my emphasis]) corresponded better to Marey's aim when it was set out 'on the same plate' (a 'figure-movement') than in an *immediate* moving image which moves forward without an intermediary (an 'image-movement'). In this case, it was then necessary to add an operation to the restitution in order to make the phenomenon comprehensible: 'manipulating' the series by slow-motion or freeze-frames.

This 'return' of the spectator, implied by the machine taking successive shots, casts doubt not only on the objectivity of the observation and the mechanical model guaranteeing it, but also on the place of the observing subject. If the spectator does not perceive the breaking down of the flight into static instants, but captures 'the exhilarating power of flying ... the maelstrom of feathers', it means that subjectivity must become attuned to the projection mechanism, to avoid, as Merleau-Ponty puts it, 'the dispersion of the self'<sup>58</sup> and maintain an imaginary unity in the imaginary world of the spectacle.

One may ask whether the evolution of the cinema would simply invalidate this question, thanks to a 'naturalisation' of the representation of movement. This is clearly not the case, however. Specialists who analyse gesture and gesticulation have encountered the same problem in their studies of kinetics, i.e., whether a dancer's gesture is 'the movement from one position to another', and what is the 'unit of the step'. It thus becomes necessary to make a distinction between structural articulations and perceptual articulations. In the 1970s, semi-oticians used the communication model to set up an opposition between the sender (the dancer), defined by *kinesthetic patterns*, and the receiver (the spectator) of the *visual patterns*.<sup>59</sup>

Marey's theory was thus at a crossroads. One entire aspect of his research could be considered to be limited to techniques, a technology of the body. Dörmann, the advocate of gymnastics, bore witness to this, as did the studies on how the foot soldier marches or the way in which Marey approached the bicycle.<sup>60</sup> But in parallel, Marey was pursuing 'pure' research that, with regard to his conceptual tools, was ever riskier. He took a greater interest in fluids than solids, in undulating phenomena whose movement, one could say, 'defines' them more than they move on the basis of the potential of their structures. According to Jakob von Uexküll, 'an amoeba is less of a machine than a horse', and it was indeed formless organisms such as the skate, the jellyfish, the veil and breath that Marey would examine.

Should one consider this an intrusion of non-Cartesian physics or even undulatory mechanics?<sup>61</sup> This clash between the Marey mechanism and 'cinema' should lead to a reformulation of the concept of movement at the very moment it occurs. Marey's reflection and what he has bequeathed to the cinema as a rational system of comprehension does not become less important because 'It is when a concept changes its meaning that it is most meaningful' (Bachelard).<sup>62</sup>

Its true importance can be seen in the fact that this dissociative and successive – in other words, discontinuous – consideration of the 'cinema', this reflection on the paradoxes of immobility and movement, quickly became a model, including for the contemporary arts of the time. What Eisenstein called 'cinematism' makes the cinematographic mechanism a general operator.<sup>63</sup> Alfred Jarry, whose *Docteur Faustroll* contains evocations that are suggestive of a 'machinic' art,<sup>64</sup> imposes a distinction between literature, which 'is obliged to make the objects it describes *file past* in succession, one by one' and 'the painting or statue' which '*captures and fixes a moment* of the duration'. 'Literature' and 'painting-sculpting' here are modalities of the cinema and photography, which implement the question of time and movement in an unusual manner.<sup>65</sup>

## Notes

1. See also 'Pour une épistémographie du montage: préalables', *Cinémas, Journal of Film Studies*, vol. 13, No. 1-2, Autumn 2002, pp. 11-32.
2. I would like to acknowledge my indebtedness to the authors of the studies on Marey I have consulted: Michel Frizot, *E-J. Marey, la photographie en mouvement*, Paris: Centre Georges Pompidou, 1977 and *Etienne-Jules Marey, chronophotographe*, Paris: Nathan-Delpire, 2001; François Dagognet, *Etienne Jules-Marey: La Passion de la trace*, Paris: Hazan, 1987; Marta Braun, *Picturing Time: the Work of Etienne-Jules Marey*, Chicago and London: University of Chicago Press, 1992; Laurent Mannoni, *Etienne-Jules Marey: La Mémoire de l'œil*, Paris and Milan: Cinémathèque française-Mazzotta, 1999.
3. The French verb 'monter' generally is thought to mean 'assemble' or 'compose' (see Jean Giraud, *Le Lexique du cinéma des origines à 1930*, Paris: CNRS, 1958).
4. At the symposium in Cerisy, August 1981: 'Méliès et la naissance du spectacle cinématographique' (published under same title by Klincksieck, Paris, 1984).
5. G. Méliès, 'Les vues cinématographiques' in *Annuaire général et international de la Photographie*, Paris: Plon, 1907, pp. 390-1.
6. According to Méliès, the Gaumont-Demeny camera was not suitable for creating effects by stopping the camera as it was not sufficiently precise, and its lack of 'freedom' let the cat out of the bag (see Jacques Malthête, Laurent Mannoni [eds.] *Méliès, magie et cinéma*, Paris: Espace Electra EDF, 2002, p. 154). André Gaudreault and more recently Laurent Le Forestier state that blurry or fogged images were *always* cut and reassembled when there was a so-called 'stop-camera' substitution (Ibid., p. 220). It thus does not seem possible that the effect was discovered by projecting a film shot by accident!
7. 'George Méliès's Mistake' ([Oshibka Georga Mel'e], *Sovietskoïe kino* no. 3-4, 1933, published in *Selected Works*, vol. 1 of *Writings, 1922-1934*, ed. and trans. Richard Taylor (London: BFI, 1988), pp. 258-60. Eisenstein, together with the experimental filmmaker Werner Nekes at a later date, objected to the terminology of linking or even substitution, and spoke of 'superposition' – 'each successive element is not positioned *next* to the last, but *above*' – superposition creates a certain tension, contradiction, non-congruence, etc. of the elements brought into play (see 'Dramaturgie der film-form' in F. Albera, *Eisenstein et le constructivisme*, Lausanne: L'Age d'Homme, 1989, p. 68). A series of inferences could be drawn from the inscription of 'montage' in a conceptual framework such as that of 'superposition', starting with the fact that this type of articulation belongs to other 'series' of images in movement – in particular the magic lantern and optical toys. Cf. the 'lantern' or 'cinematographic' metaphor used by Marcel Proust, who makes a clear distinction between super(im)position (in perception) and succession (on the material medium, as it were): '... the superimposition ... of the successive images which Albertine had been for me, ... in a germination, a carnal efflorescence' (*La Prisonnière*, Paris: Gallimard-Pléiade, 1965, translated by C.K. Scott Moncrieff, *The Captive*, <<http://ebooks.adelaide.edu.au/p/proust/marcel/p96c/chapter1.html>>, accessed 21 September 2008).
8. See, in particular, 'Les traces de montage dans la production Lumière' [1995] in P. Dujardin, A. Gardies, J. Gerstenkorn, J.-C. Seguin (eds.), *L'Aventure Lumière Actes*

- du *Congrès mondial Lumière*, Lyon: Aléas, 1999, pp. 299-306 (the article contains a bibliography of previous papers) and 'Fragmentation et segmentation dans les "vues animées"' in F. Albera, M. Braun, A. Gaudreault (eds.), *Stop Motion, Fragmentation of Time*, Lausanne: Payot, 2002, pp. 225-245.
9. In the beginning of the 1970s, Werner Nekes began defining montage as an articulation between two photograms (the *kineme*). He gave weight to this idea by inscribing it in a large collection of toys and machines, going from the simplest – the thaumatrope – to the most complex – the cinema. See W. Nekes, 'Whatever happens between the pictures', *Afterimage* (New York), vol. 5, no. 5, November 1977, pp. 7-13. Nekes was the first person to extrapolate Eisenstein's ideas, as set out in 'Dramaturgie der film-form' (1929).
  10. François Dagognet's paper, followed by Michel Foucault's contribution, can be found in: F. Dagognet, *Les Outils de la réflexion [Epistémologie]*, Le Plessis-Robinson, les Empêcheurs de penser en rond, 1999 (pp. 214-231) and Foucault's contribution together with the whole of the discussion – including the other participants – in: M. Foucault, *Dits et écrits 1954-1988*, Paris: Gallimard, 1994, vol. II (pp. 27-66).
  11. A. Fontana, P. Pasquino, "Intervista a Michel Foucault" in *Microfisica del potere: interventi politici*, Torino, Einaudi, 1977 (also published in M. Foucault, *Dits et écrits*, op. cit., vol. III, p. 143). English version: *The Essential Works of Michel Foucault, 1954-1984. vol. 4 Power*, edited by James D. Faubion, Translated by Robert Hurley and others, London: Allen Lane-Penguin, 2001. The quotation is on p. 114.
  12. Even though he is sometimes criticised on these grounds, or this teleology is forced upon him: 'He lost interest in the cinematograph that was both called for and necessitated by his work ... The Lumière brothers stole his victory from him' (F. Dagognet); 'E.-J. Marey ... was unable to go to the end of the path that led to the cinematograph' (M. Sicard).
  13. Marey was one of the 'third generation' of successors of Cuvier at the *Collège de France* (chair of natural history of organised bodies).
  14. These three points merit further development – which cannot be undertaken here as they lead to a history and an epistemology of the 'cinema'. One may simply point out that once one has sidelined the conception of history as a chronological series producing its results following the logic of what engenders what, or how things fit together – and it has been severely criticised during the last twenty years – there remains the question of the 'logical' construction with which epistemology proceeds, starting from the present. On this subject, see: Michel Fichant, 'l'Idée d'une histoire des sciences' in: M. Fichant, M. Pêcheux, *Sur l'histoire des sciences*, Paris: Maspéro (coll. Théorie), 1969, pp. 49-139.
  15. I use this all-encompassing expression for convenience, but without a finalised meaning. 'Cinema' (in quotes) is neither cinematograph nor cinema. It includes both the zoetrope and chronophotography.
  16. See the most recent large-scale synthesis on the subject undertaken by Laurent Mannoni, in the English translation by Richard Crangle: *Great Art Of Light And Shadow: Archaeology of the cinema*, Exeter: University of Exeter Press, 2000.
  17. This formulation is obviously not intended to overlook the close links that indeed exist between the physiology of perception, astronomy and the study of movement. Pierre-Jules César Janssen, an astronomer with a doctorate in physical sciences had, moreover, defended his PhD on vision.



18. *La Méthode graphique dans les sciences expérimentales et principalement en physiologie et en médecine*, Paris: Masson, 1885 [1878], p. XI.
19. 'Particular moment' is an expression used by Marey in *Le Mouvement*, Paris: Jacqueline Chambon, 1994 [1894]; *Movement*, translated by Eric Pritchard, London: William Heinemann, 1895, p. 54.
20. At first sight, the movement of an 'inanimate' – so to speak – moving body, such as a 'bright ball' thrown within the apparatus's field of vision (this is Marey's example in his definition of chronophotography) can be distinguished from the movement of an 'animate' moving body, and its trajectory should come close to that of celestial mechanics, but in the case of the ball, Marey examined the phases of immobility that mark the end of the movement in one direction, and the imminence of its starting up again in the other direction – which he calls 'dead points' (*Movement*, op. cit. p. 177).
21. Alphonse Allais's sarcastic remarks about Edison speak chapters about the importance of national competition between inventors (see 'Chez Edison' in *Le Parapluie de l'escouade* (1893), *Cœuvres anthumes*, Paris: Robert Laffont "Bouquins", 1989, pp. 330–331, which find an echo in Perrigot's indignation when the Swiss National Exhibition of 1896 contemplated featuring the Cinematograph in the Edison pavilion. 'If there were a Marey pavilion, we would be able to house ourselves under the French flag' (Jacques Rittaud-Huttinet, Yvelize Dentzer (eds.), *Auguste et Louis Lumière Correspondances 1890-1953*, Paris: Cahiers du Cinéma, 1994, pp. 139–140).
22. See his letter to the Minister of Commerce of 22 May 1900 (*Auguste et Louis Lumière Correspondances 1890-1953*, op. cit., p. 173).
23. Leaving aside Demeny's attempt to market his system of driving the film and his own projection apparatus, Marey tried in vain to sell the patented processes of the chronophotograph to the Lumière brothers (Letter of 18 August 1899 in: *Auguste et Louis Lumière Correspondances 1890-1953*, op. cit., p. 171).
24. The (greater) majority of the terms listed are part of Marey's vocabulary, picked out during the reading of his main works: *Du Mouvement dans les fonctions de la vie*, *Animal Mechanism* and *Movement*.
25. In the sense put forward by Michel Foucault in *The Order of Things: An Archeology of the Human Sciences*. London and New York: Routledge 2002, p. 79 ff.
26. This is the domination of the machine over the body by rationalisation of the animal mechanism, pointed out by Siegfried Giedeon in *La Mécanisation au pouvoir*, Paris: Centre Pompidou, 1980 [*Mechanization Takes Command*, New York: Oxford University Press Inc., 1948] and developed by Anson Rabinbach, *The Human Motor: Energy, Fatigue, and the Origins of Modernity*, New York: Basic Books, 1990.
27. Alfred Jarry, 'How to Construct a Time Machine' ('Commentaire pour servir à la construction pratique de la machine à explorer le temps', *Mercure de France*, no. 110, February 1899, pp. 387–396), translated by Roger Shattuck, <<http://dev.null.org/psychoceramics/archives/1995.12/msg0065.html>>, accessed 21 September 2008.
28. 'In kinematics, duration plays the part of an independent variable, of which the co-ordinates of the points considered are a function' (A. Jarry, *Ibid.*) The 'time machine' that Jarry mentions in this text is meant to foster 'absolute' knowledge based on immobility and transparency. Several allusions to optical machines can be found in this text (including cinema in the form of 'reversibility of phenomena' and 'the visual aspect of succession' – 'One sees the apple bounce back up into the tree, the dead



- man comes to life, and the cannon ball re-enters the cannon.' [op. cit.] – which will later be the source of such inspiration for Jean Epstein) with special emphasis put on panorama (op. cit.).
29. Reflections linking the question of body movement, walking and dancing to their filming by Kuleshov (see: *L'Art du cinéma et autres écrits (1917-1934)*, Lausanne: L'Age d'Homme, 1990), Renoir (regarding *Nana*) and Benjamin (on Chaplin), and more widely addressing the problems of 'expressive movement' (Eisenstein-Tretiakov).
  30. A. Rabinbach, op. cit., p. 115.
  31. J.-C. Beaune, *L'Automate et ses modèles*, Paris: Flammarion, 1980, p. 223.
  32. In 1886, in a letter to Demenÿ, he mentioned the plan of a lecture entitled the 'application of mechanics to biology'. Elsewhere he speaks of the 'mechanics of organs' and the 'mechanics of the jump' (see G. Demenÿ, *Les Origines du cinématographe*, Paris: Henry Paulin, 1909, p. 47. The lecture was called: 'Biologie. Collège de France – Histoire naturelle des corps organisés, leçon d'ouverture. Des lois de la mécanique en biologie.' *Revue scientifique* 3. VII. 1886 no. 1, quoted in T. Lefebvre, J. Malthête, L. Mannoni (eds.), *Lettres d'Etienne-Jules Marey à Georges Demenÿ, 1880-1894*, Paris: AFRHC-BIFI, 1990, p. 189 note 1).
  33. 'And one can well compare the nerves of the machine that I am describing to the tubes of the mechanisms of these fountains, its muscles and tendons to divers (sic) other engines and springs which serve to move these mechanisms ...' (*L'Homme, Œuvres philosophiques* I, Paris: Garnier, 1997, p. 390; *Treatise of Man*, French text with translation and commentary by Thomas Steele Hall, Cambridge, MA, Harvard University Press, 1972, p. 22).
  34. J.-E. Marey, *Recherches sur la circulation du sang à l'état physiologique et dans les maladies*, doctoral thesis in medicine of 1859, quoted by L. Mannoni, *Etienne-Jules Marey: La Mémoire de l'œil*, op. cit., p. 25. Cf. Descartes (speaking of the functions in the 'machine' such as the digestion, the beating of the heart, food and the growth of its members): '... it is not necessary to conceive in it any other vegetative or sensitive soul ... than its blood and its spirits, agitated by the heat of the fire that burns continually in its heart ...' (Quoted by F. Dagognet, *Philosophie biologique*, Paris: Presses Universitaires de France, 1955, p. 7, English translation <<http://alepho.clarku.edu/huxley/CE1/DesDis.html#note7>>, accessed 21 September 2008). The same argumentation can be found in *Les Passions de l'âme* (1st part, article 5, *Œuvres philosophiques* III, Paris: Garnier, 1989, p. 954).
  35. François Jacob in *La Logique du vivant* (Paris: Gallimard, 1970) evinces this condition of possibility of knowledge in the classical period linked to the mechanism and that is curtailed by vitalism, notwithstanding the fact that G. Canguilhem has analysed the paradoxical 'liberating' function that vitalism was able to have, in particular for Claude Bernard. Canguilhem, however, agreed after reading Jacob that vitalism was henceforth 'out of the running' (see 'Logique du vivant et histoire de la biologie', *Sciences*, no. 71, March-April 1971, p. 23).
  36. *Discours de la méthode* in: *Œuvres philosophiques* I, Paris: Garnier, 1997, p. 623; *A Discourse on Method*, Translated by John Veitch, LL.D., Introduction by A.D. Lindsay, London: J.M. Dent & Sons Ltd., New York: E.P. Dutton & Co. Inc., 1953 (1912). But it is also necessary to wind up the watch, the automaton or the machine, i.e., it contains 'the corporeal principle of those movements for which it is designed along

with all that is requisite for its action' and not 'broken' (dead, inert). (*The Philosophical Works of Descartes I*, rendered into English by Elizabeth S. Haldane, CH, LLD, and G.R.T. Ross, MA, D Phil, London: Cambridge University Press, 1931 (1911), p. 333).

37. See the *Discourse on Method* 5th part – the description of the functioning of the heart – for example.
38. 'To say that the successive photographs – leaving aside the cinematic solution that they contain – would encompass the *dynamic* solution if one were able to photograph the successive positions of the centre of gravity' (quoted in: T. Lefebvre, J. Malthête, L. Mannoni, op. cit., p. 140). My italics.
39. Claude Bernard 'denounces the study of organic functions by anatomic deduction, the subordination of physiology to anatomy,' wrote G. Canguilhem ('Claude Bernard et Bichat' in *Etudes d'Histoire et de Philosophie des Sciences*, Paris: Vrin, 1970, p. 161), but his physiological functionalism still remains 'narrowly analytical because too faithful to morphological decomposition' (Ibid). In fact, he recommends vivisection.
40. Paul Valéry congratulated him on replacing the 'discreet signs that are arbitrarily established' by the 'traces of the things themselves or even by transpositions or inscriptions deriving from them directly' ('Notes et digressions', 1919, *Œuvres*, vol. I, Paris: Gallimard "La Pléiade", p. 1266).
41. F. Dagognet, *Etienne-Jules Marey ...* op. cit., p. 137.
42. Letter to G. Demenÿ of 21 November 1884, in T. Lefebvre, J. Malthête, L. Mannoni, op. cit. p. 137. The drum in question is a cylinder around which the rope that transmits the 'information' to the apparatus that measures the horses' paces is wound.
43. Paris: Baillière et fils, 1858.
44. London: Longmans Green & Co., 1879.
45. Paris: Renouard, 1862.
46. L. Mannoni, op. cit., p. 80.
47. Albert Londe, 'Appareil photo-électrique', *Bulletin de la Société Française de Photographie* no. 5, vol. 30, May 1883, p. 127 (quoted by Denis Bernard & André Gunthert, in *l'Instant rêvé Albert Londe*, Paris: Jacqueline Chambon, 1993, p. 134).
48. The evolution from the photograph of the document to the research instrument is analysed by Denis Bernard & André Gunthert, op. cit., chap. 3.
49. 'Le Vol des oiseaux', *La Nature*, June 1883, p. 37 (quoted F. Dagognet, *Marey*, op. cit., p. 78).
50. Marey to Davanne in: Alphonse Davanne, 'Inventions et applications de la photographie' (1891) (quoted by Denis Bernard and André Gunthert op. cit., p. 153).
51. Quotation from *La Nature* (22 March 1879) and *The Horse in Motion*, quoted in J. Mitry (ed.), 'Le cinéma des origines', *Cinéma d'aujourd'hui*, no. 9, autumn 1976, p. 60. My italics.
52. Not that Marey does not refer to it – on the contrary, he was keen both to give scientific data to scientists and exact references to painters, whom he regularly introduced as beneficiaries when setting out his discoveries (there is an example in *La Machine animale*, [1873] p. 158). But one cannot draw conclusions about Marey's conceptualisation of movement – it is more a question of social utility and allusion to a type of representation within everyone's reach (Descartes also uses the comparison with the painter in his *Discourse*, and before him Galileo). It is a secondary benefit.

53. *Movement*, op. cit., pp. 194-5.
54. A distinction is made between the two terms when the aims of the experiences set out in *la Machine animale* are put forward: 'from the physiologist's point of view one must ask them to express actions and reactions at great speed, the energy and duration of each movement, the rhythm of their successions. But the artist is not less interested to know exactly the attitude corresponding to each instant of a walk in order to represent it faithfully with the various poses that characterise it.' (op. cit., p. 158).
55. Marey speaking of Muybridge, *la Nature*, 28 December 1878 (quoted by L. Mannoni, op. cit., p. 155).
56. D. Bernard, A. Gunthert, op. cit., p. 174.
57. Albert Londe (1888) quoted by A. Gunthert, 'Esthétique de l'occasion', *Etudes photographiques* no. 9, May 2001, p. 87, note 31.
58. M. Merleau-Ponty, *Phénoménologie de la perception*, Paris: Gallimard "Tel", 1994 [1945], p. 318. Bergson was a contemporary of Marey's, and was thus mindful of the 'cinematographic mechanism', whereas Merleau-Ponty no longer took the mechanism into account but only the effect, or 'melody' as he put it. Even a strong advocate of the elusive 'photogeny', such as Epstein, saw this as 'a spark, an exception caused by jerks' (*Bonjour cinéma!*).
59. See Nicole Scotto di Carlo, 'Analyse sémiologique des gestes et mimiques des chanteurs d'opéra', *Semiotica* IX, 4, 1973 (pp. 289-317), Paul Ekman, Wallace V. Friesen, Silvan S. Tomkins, 'Facial Affect Scoring Technique: A First Validity Study', *Semiotica* III, 1, 1974 (pp. 37-58) and especially Margot D. Lasher, 'The Pause in the Moving Structure of Dance', *Semiotica* 22, 1/2, 1978, pp. 197-126, from whom I have borrowed the expressions in italics.
60. See the discussion on the bicycle during the meeting of 18 September 1894 at the *Académie de médecine*. Marey, who quickly stressed that he was no cyclist, immediately thought of improving the cyclist's performance by calculating the movement of the pedals in relation to the body's centre of gravity (*Bulletin de l'Académie de médecine*, 1894, pp. 278-280).
61. It should be noted that in 1864, Louis Ducos du Hauron patented an apparatus capable of capturing 'any scene with all the transformations that it has undergone during a specific time period', and underlined its capacity to capture 'the movements of a dancer, one or several soldiers, a machine, facial expressions, a maritime scene, waves, clouds moving or the eruption of a volcano ...' (quoted by G.-Michel Coisac, *Histoire du cinématographe*, Paris: Éditions du Cinéopse, 1925, pp. 89-91).
62. Gaston Bachelard, *The New Scientific Spirit*, translated by Arthur Goldhammer, foreword by Patrick A. Heelan, Boston: Beacon Press, 1984, p. 54.
63. See, in particular, S.M. Eisenstein, *Cinématisme Peinture et cinéma*, Dijon: Les Presses du Réel: 2009, [1980] and *Le Mouvement de l'art*, Paris: Cerf, 1989.
64. A. Jarry, *Gestes et opinions du docteur Faustroll, 'pataphysicien'*, roman néo-scientifique, Paris: Gallimard "Poésie", 1980 [1897-1911].
65. A. Jarry, *Le Temps dans l'art* (lecture of 8 April 1902 at the *Société des Artistes Indépendants*), Paris: L'Echoppe, 1995. Speaking of the legend of Lot's wife, he wrote: 'Then the Lord said: "Move no more!"' (p. 9). In Lenz, Georg Büchner's fascinating unfinished text from 1778, the eponymous poet undertakes a somewhat frenzied walk in the mountains that leaves him quite breathless and exhausted, and muses on the

sights and images (evoking 'the play of shadows', 'scenes' and also 'instants') leading him to the following observation: 'Yesterday as I walked up the valley I saw two girls sitting on a stone, one putting up her hair, the other helping ... *Sometimes one would like to be a Medusa's head to be able to turn such a tableau to stone, then shout to everyone to come and look.* They stood up, the beautiful tableau was gone forever; but as they clambered down amongst the rocks *there was yet another picture. The most beautiful images, the most resonant harmonies, coalesce, dissolve.* Only one thing abides: an infinite beauty that passes from form to form, eternally changed and revealed afresh, though needless to say you can't capture it and stick it in museums ...' *Complete Plays, Lenz and Other Writings: Danton's Death; Leonce and Lena; Woyzeck; Lenz; the Hessian Messenger; on Cranial Nerves; Selected Letters*, translated by John Reddick, Harmondsworth, Penguin Classics, 1993 [my italics]. The desire to be a 'Medusa's head', to transform people that one meets into stone statues in order to show them to others, portrays the *place* of photography – and even of *cinematography* ('there was yet another picture').